Annex to:

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Annex B – Methodological considerations in the calculation of intake estimates for dietary sugars in European countries

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1. Sources of food composition data

1.1. EFSA Nutrient Composition Database

Composition data for total sugars in foods and beverages were derived from the EFSA Nutrient Composition Database, which was compiled as a deliverable of the procurement project 'Updated food composition database for nutrient intake' (Roe et al., 2013). The project provided EFSA with an updated food composition database covering approximately 1,750 food entries and additional facet descriptors included in the EFSA classification system (FoodEx2, see Section 2), harmonised information on the most common composite recipes of European countries, and information on food supplements. If no country-specific data were available for certain food codes, data compilers borrowed compatible data from other countries and/or from similar foods. The EFSA food composition database contains data for energy, macro- and micronutrients from national food composition databases up to 2012 provided by 14 national food database compiler organisations. Data on total sugars were provided by 12 countries.

Data on the content of single mono- and disaccharides in foods in the EFSA Nutrient Composition Database are scarce and not adequate to provide estimates of intake for individual types of sugars. This paucity of data was confirmed in the questionnaires compiled by the National Competent Authorities of European Countries.

1.2. The Mintel's Global New Products Database

The Mintel's Global New Products Database (GNPD) was used to check and subsequently to integrate the sugar content of foods and beverages according to the nutrition information indicated on the labels of the packaging and the ingredients list[1]. It is an online database that monitors new introductions of packaged goods in the market worldwide. It contains information on over 3 million food and beverage products of which more than 1,100,000 are or have been available on the European food market. Mintel started covering European food markets in 1996, currently having 25 out of its 27 Member States and UK and Norway represented. Total sugars are among the nutritional information subject to mandatory labelling in the EU (Regulation EU No 1169/2011[2]).

The database was accessed in the second half of 2018 and beginning of 2019 to develop the food composition database on total sugars, in September–October 2019 when developing the food composition databases on added and free sugars, and between June and September 2020 to check the alcohol content of beverages in the market to calculate energy intake from alcohol.

2. Food classification

The food composition and consumption data used for the assessment of total, added and free sugars intake were classified according to the 'exposure hierarchy' of the FoodEx2 classification and description system to facilitate the linkage between occurrence/composition data and food consumption data when assessing exposure/dietary intake. FoodEx2 includes a list of more than 4,500 entries, referred to as 'FoodEx2 basic codes'. These were aggregated into food groups and broader food categories in a hierarchical parent–child relationship (up to seven levels) from the very generic (e.g. level 1, grain and grain-based products) to the very specific level (e.g. level 7, cream cheesecake). In addition, a catalogue of 28 'facets' is available to describe further characteristics of the foods, such as physical state (e.g. powder, liquid, etc.) or processing technology (e.g. grinding, milling, crushing, etc.). Details on the FoodEx2 classification system are available in the dedicated page of the EFSA website[3].

[1] https://www.mintel.com/global-new-products-database
[2] https://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2011:304:0018:0063:EN:PDF
[3] http://www.efsa.europa.eu/en/data/data-standardisation

3. Development of the EFSA food composition database on total sugars

3.1. Data cleaning and validation

After removing duplicates (borrowed values), in total 8,337 unique records on total sugars were available in the EFSA Nutrient Composition Database, which related to 1,290 different FoodEx2 basic codes (Table 1).

Table 1: Number of unique records provided by the 12 countries in the EFSA Nutrient Composition Database

Country	Count of records
Denmark	512
Finland	886
France	731
Germany	2569
Greece	204
Iceland	334
Italy	632
Netherlands	934
Portugal	440
Serbia	15
Slovenia	130
United Kingdom	950
Grand Total	**8337**

Consistency of FoodEx2 codes, original food name in English (freely entered text) and total sugar content of the given foodstuff were checked for all records. In total, 181 food items have been recoded due to inaccurate FoodEx2 classification (e.g. 'fruit soft drink' with a sugar content of 1.5 g/100 g recoded to 'diet soft drink with fruit juice') or incorrect coding (e.g. fruit juice from mixed fruits with total sugar content 11.4 g/100 g being coded as e.g. aubergine).

The variability in total sugar content was evaluated for each FoodEx2 code. National records in the database generally reflect the variability of products on the global market. In case of outliers, possible misclassification of the food or misreporting of the sugar content was checked (e.g. the label of the original product was found on the internet) and subsequently corrected. If confirmation was needed or insufficient data were available, Mintel GNPD and/or other freely available composition tables were consulted (McCance & Widdowson[4], USDA[5]). In total, 224 outliers were deleted because it was not possible to confirm the relatively high or low values in the Mintel GNPD or freely available composition tables.

3.2. Establishing the linking categories and selection of the representative FoodEx2 level

To match the total sugar content from the EFSA Nutrient Composition Database with the foods reported in the EFSA Comprehensive European Food Consumption Database (Section 5), linking categories were established. Linking categories were mostly established based on the distribution of total sugar values within each FoodEx2 level, which was investigated with boxplot analysis. When total sugar values were homogeneous at a certain FoodEx2 level, no further distinction was made (e.g. jams from different fruits had similar sugar content). In addition to FoodEx2 levels, sugar-related facets were used to

[4] Available at https://www.gov.uk/government/publications/composition-of-foods-integrated-dataset-cofid
[5] Available at https://fdc.nal.usda.gov/

establish linking categories when relevant (e.g. 'jams and marmalades, reduced sugar'). FoodEx2 levels and the corresponding linking categories can be found in **Annex C**, **Table 2**.

In total, 578 distinct linking categories have been established, representing the total of 2,573 FoodEx2 code – sugar related facet combinations reported in the EFSA Comprehensive European Food Consumption Database and covering the food consumption of all age groups in the European population. Dilution factors (EFSA, 2018) have been applied to the corresponding linking category so that all foodstuffs are considered in their consumed state (e.g. simple cereals to be reconstituted, liquid and powdered drink bases, etc.).

The EFSA food composition database on total sugars used to estimate total sugar intakes can be found in **Annex C**, **Table 1**.

4. Development of the EFSA food composition databases on added and free sugars

4.1. Practical definitions of added and free sugars for the purpose of developing the food composition databases

All food items reported in the EFSA Comprehensive European Food Consumption Database are coded according to FoodEx2, as described previously (Section 3.2). Depending on the level of detail available in the original food description, the corresponding FoodEx2 category can be more or less specific. When the exact product consumed was not specified at national level (e.g. cookies, with no specification of the type or brand), so that the ingredient used for sweetening purposes (e.g. sucrose, fructose, syrups, honey, fruit juice concentrates, other) was not specified, the amount of added and free sugars originating from the different ingredients could not be assigned. Therefore, for the only purpose of developing the food composition databases for added and free sugars, the following definitions were used (Figure 1):

- Added sugars: all mono- and disaccharides used as sweetening ingredients, including sugars in honey, syrups, fruit and vegetable juices, and fruit and vegetable juice concentrates that are added to processed and prepared foods.
- Free sugars: all added sugars plus all sugars naturally occurring in fruit and vegetable juices, fruit and vegetable juice concentrates, honey and syrups when used as such by consumers.

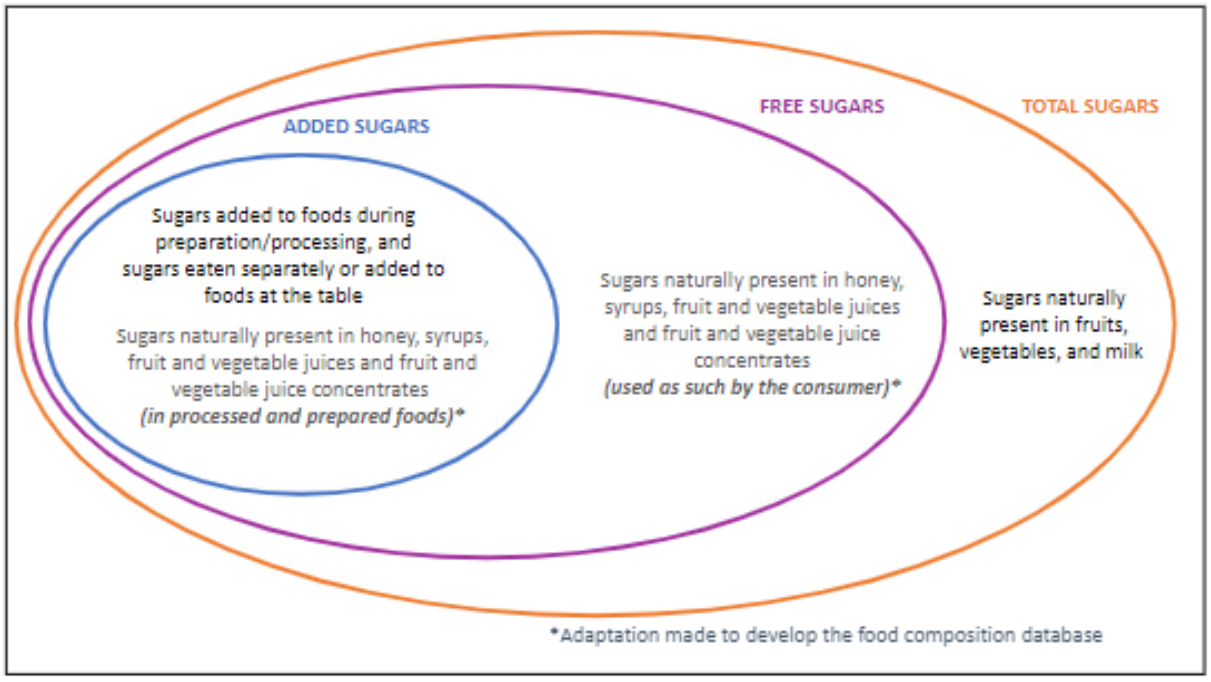

Figure 1: Modified definitions of added and free sugars for the development of the food composition database

4.2. Principles to estimate added and free sugars from total sugars

Levels of added and free sugars were derived for the 578 distinct linking categories established in the food composition database for total sugars, as described in Section 3.2.

The procedure by (Wanselius et al., 2019), developed from previous methods for estimation of added sugars content in foods by (Louie et al., 2015) and for estimation of free sugars content by (Kibblewhite et al., 2017), was systematically used as the basis for the estimation of added and free sugars in the distinct linking categories. The procedure works in a 10-step manner based on a food total sugars value of linking categories. If assumptions and/or conditions are met, the linking category falls under a step number from 1 to 10 and an added and free sugars content estimates can be made. The procedure contains six steps of objective decisions (steps 1–6) and four steps of subjective decisions (steps 7–10). Three steps (steps 4, 6 and 9) were not applicable in this case. Steps 4 and 9 were not applicable because they refer to composite foods and are based on a standardised recipe calculation method, whereas in the EFSA Comprehensive Food Consumption Database most composite dishes are disaggregated into their ingredients and reported as such. Step 6 was not applicable because it relies on the known content of lactose and/or fructose in the food item, and this information was not available in the EFSA's food composition database:

- Step 1: linking categories containing 0 g of total sugars (e.g. fats and oils) were assigned a value of 0 g/100 g of added and free sugars.
- Step 2: linking categories considered to contain total sugars but no added or free sugars (e.g. pasta, bread) were assigned a value of 0 g/100 g of added or free sugars.
- Step 3: linking categories considered to have no or minimal amounts of naturally occurring sugars (e.g. soft drinks without fruits) were assigned a value for added or free sugars corresponding to 100 % of total sugars.
- Step 5: the amounts of added and free sugars were estimated based on the comparison with an unsweetened variety of the food (e.g. milk and flavoured milk with sugar).
- Step 7: the amount of added and free sugars was estimated based on a similar food. The added or free sugars value was either borrowed from a similar food and applied directly to the linking categories of interest or used as a basis to make an estimation (e.g. linking category 'dairy ice cream and similar' borrowed its free and added sugar contents from 'ice cream, milk based').
- Step 8: the amount of added and free sugars was estimated based on recipe proportions in composite food products containing various ingredients. When information on recipes was needed (e.g. recipe for chocolate filled croissants), those described in the EFSA Technical Report 'The raw primary commodity (RPC) model: strengthening EFSA's capacity to assess dietary exposure at different levels of the food chain, from raw primary commodities to foods as consumed' were used.
- Step 10: when the assumptions from the previous steps were not applicable, the contents of added or free sugars were assumed to be equal to 50% of total sugars. The application of this step affected only ~1% of the food consumption occasions of the Comprehensive Database (see Section 5) (e.g. free and added sugar content of not further specified food categories that includes various food products consumed in a small quantity; however exact products were not possible to be identified: 'Mixed and other not listed condiments', 'Products for non-standard diets, food imitates and food supplements', 'Savoury sauces').

In each step, the Mintel GNPD was used to investigate whether food items contained added or free sugars based on their label information on ingredients and/or nutritional values, and subsequently to integrate this information.

4.3. Process to estimate added and free sugars

The contents of added and free sugars were systematically estimated and assigned to all linking categories established for total sugars in the EFSA composition database. All categories that contained < 0.1 g/100 g of total sugars were assigned to step 1. Subsequently, contents of added and free sugars were estimated for each of the categories according to the specified steps.

Out of the 578 linking categories established from the EFSA composition database on total sugars, 224 (39%) were considered to contain added sugars and 262 (45%) to contain free sugars. Applying objective steps (steps 1–5) added sugars estimates were assigned to 482 (83%) linking categories and free sugars estimates to 501 categories (87%). The complete spread of step number assignments is depicted in Table 2.

Table 2: Step distribution for estimates of added and free sugars in all linking categories established from the EFSA food composition database on total sugars

Step number and description	**Number of linking categories (%)**	
	Added sugars	**Free sugars**
1) Foods with 0 total sugars	33 (6)[(a)]	33 (6)[(a)]
2) Foods with 0 added or free sugars (but not 0 total sugars)	321 (56)[(a)]	283 (49)[(a)]
3) Foods for which content of total sugar equals to free or added sugars	93 (16)	151 (26)
4) Not applicable	–	–
5) Added or free sugar content is based on the comparison of sweetened and unsweetened varieties	35 (6)	34 (6)
6) Not applicable	–	–
7) Borrowing added or free content from a similar food	10 (2)	8 (1)
8) Standard recipe from EFSA's RPC database	44 (8)	34 (6)
9) Not applicable	–	–
10) None of the above are applicable: added or free are assumed to be 50% of total sugar content	42 (7)	35 (6)
Total number of food categories	578 (100)	578 (100)

(a): Linking categories within steps 1 and 2 are assigned 0 g of added and free sugars.

The EFSA food composition databases on added and free sugars used to estimate intakes of added and free sugars can be found in **Annex C**, **Table 1**.

5. The EFSA Comprehensive European Food Consumption Database

The EFSA Comprehensive European Food Consumption Database (Comprehensive Database) provides a compilation of existing national information on food consumption at individual level and was first built in 2010 (EFSA, 2011b, a; Huybrechts et al., 2011). Details on how the Comprehensive Database is used are published in the guidance from EFSA (EFSA, 2011b). The latest version of the Comprehensive Database, updated in 2020, contains results from a total of 69 different dietary surveys carried out in 25 different European countries covering 134,929 individuals.

Within dietary surveys, subjects are classified in different age classes (population groups) as follows:

Infants:	≥ 4 to < 12 months old
Toddlers:	≥ 12 months to < 36 months old
Other children:	≥ 36 months to < 10 years old
Younger adolescents:	≥ 10 years to < 14 years old
Older adolescents:	≥ 14 years to < 18 years old
Adults:	≥ 18 years to < 65 years old
Older adults:	≥ 65 years old

For this opinion, infants less than 4 months old were excluded from the assessment as it was assumed that they were exclusively breastfed or fed with breast milk substitutes (EFSA NDA Panel, 2018) and adolescents were split into two subgroups as their diet differs in terms of some food groups (e.g. consumption of alcoholic drinks).

Seven additional surveys provided information on specific population groups, five on pregnant women (15–48 years old) and two on lactating women (18–45 years old).

For habitual dietary intake assessment, food consumption data were available from 44 different dietary surveys carried out in 23 different European countries. In most cases, when for one country and age class different dietary surveys were available, only the most recent was used. However, when two national surveys from the same country gave a better coverage of the age range, both surveys were kept (e.g. two surveys in toddlers in the United Kingdom). Dietary surveys with only 1 day per subject were excluded from the current assessment because they were deemed to be inadequate to assess habitual intake. This resulted in a total of 44 dietary surveys selected to estimate the intake of total, free and added sugars. Details on the characteristics of these surveys (name, population group covered, number of subjects, number of consumption days recorded, and dietary method used) can be found in **Annex C**, **Table 4**.

Consumption data were collected using repeated 24-hour dietary recalls or dietary records covering from 2 to 9 days per subject. Because of the differences in the methods used for data collection, direct country-to-country comparisons can be misleading.

Energy intake was not calculated using the EFSA Comprehensive Database because the database could not be checked and cleaned for all energy-contributing macronutrients within the time and resources available. Therefore, data on total energy intake reported by data providers were used. This information was not available for all surveys and population groups. Daily energy intake reported for each participant (mean intake for the whole survey period) was used to calculate intakes of total, added and free sugars as the percentage of total energy (%E). As different methodologies, assumptions and national food composition databases may have been used to calculate energy intakes for each survey, between-country comparisons for sugar intakes expressed as %E should be read with caution. To check the validity of energy intake estimates across surveys, total energy expenditure was calculated at individual level from body weight using the prediction equations for resting energy expenditure by Henry (2005) and assuming a physical activity level (PAL) of 1.4. Owing to a difference > 25% between calculated mean total energy expenditure and reported mean energy intakes, data on energy intake in three surveys, namely DANSDA 2008 (Denmark), AT-ADOLESCENTS-2018-2 (Austria) and ENALIA 2 (Spain) were not considered in the assessment. Summary statistics of the available energy intakes and the calculated total energy expenditure are shown in **Annex C**, **Table 5**.

For infants, breastmilk consumption was assessed according to different methodologies across surveys.

6. Intake assessment methodology

Dietary intakes of total, added and free sugars in g/day were calculated by linking food consumption data at individual level in the Comprehensive Database (Section 5) to food composition data at the relevant linking category (Section 3.2). For each dietary survey, the average daily consumption of each food item was combined with its content of total, added and free sugars. The resulting intakes per food item were summed up to obtain total daily intakes of total, added and free sugars for each individual. The mean and the P95 of intakes were subsequently calculated for each survey by population group and sex, when appropriate.

Intakes of total, added and free sugars as non-alcohol %E were also calculated, using mean energy intakes reported by data providers at individual level in the Comprehensive Database. Alcoholic drinks reported to be consumed in the Comprehensive Database were selected and grouped by their assumed alcohol content (%) (**Annex C**, **Table 3**).

Considering the alcohol content of a drink, the amount of the drink consumed, and that 1 g of alcohol provides 7 kcal, energy intake from alcohol was calculated for each individual as the mean of all surveyed days. Energy intake from alcohol was then subtracted from total energy intake to obtain non-alcohol energy intake and to calculate intakes of total, added and free sugars as non-alcohol E% (**Annex C**, **Table 5**).

Food groups contributing to the intake of dietary sugars have been constructed by clustering the linking categories in different ways (Table 3). For the whole population, the purpose was to identify major sources of dietary sugars and calculate sugar intakes coming from both core foods (i.e. foods supplying most macro- and micronutrients in the diet as recommended in FBDGs) and non-core foods (i.e. foods that could be removed from the diet without substantially affecting its nutritional quality). Minor contributors to sugar intakes are clustered under the miscellaneous group 'others' (e.g. meat products, food supplements, oilseeds). Non-core food groups being major contributors to the intake of added and free sugars have been broken down further to identify consumer groups of interest (consumers only). Detailed information about the linking categories clustered under each food group is provided in **Annex D**, **Tables 6–8**.

Table 3: Food groups contributing to the intake of dietary sugars in the whole population and food groups used to define consumer groups[(a)]

Food groups (whole population)		**Food groups (consumers)**	
Short name	**Description**	**Short name**	Description
SUGARS AND CONFECTIONERY	Sugar and similar (i.e. table sugar, honey and syrups), confectionery and water-based sweet desserts	**SUGAR AND SIMILAR**	Table sugar, honey and syrups
		CONFECTIONERY	Confectionery and water-based sweet desserts
SSSD+SSFD	Soft and fruit drinks sweetened with sugar	**SSSD+SSFD**	Soft and fruit drinks sweetened with sugar
FINE BAKERY WARES	e.g. cakes, biscuits, pastries	**FINE BAKERY WARES**	e.g. cakes, biscuits, pastries
FRUIT/VEG JUICES	Fruit/vegetable juices and nectars	**FRUIT/VEG JUICES**	Fruit/vegetable juices and nectars
FRUIT/VEG_processed	Processed fruits and vegetables excluding beverages		
FRUIT/VEG_fresh	Fresh fruits, vegetables		
CEREALS	Cereal and cereal-based products including bread but excluding fine bakery wares		
MILK AND DAIRY	Milk and dairy products including dairy alternatives		
BABY FOODS	Foods for infants and young children		
ALCOHOLIC BEV	Alcoholic beverages		
OTHERS	Others		

(a): Detailed composition of each food group can be found in Annex D (Tables 6–8).

In most surveys, data were disaggregated for composite dishes only, but not for food products purchased as such. A notable exception was surveys for infants, toddlers, other children and adolescents in Finland, for which data were provided disaggregated for some food groups, namely fine bakery wares and milk and diary. For this reason, the contribution of these food groups to the intake of total/free/added sugars could be unusually low, whereas the contribution of sugars and similar could be unusually high in these population groups compared with other countries. This was highlighted in Section 4.3 of the opinion when appropriate.

All analyses were conducted using SAS Statistical Software (SAS enterprise guide 7.1).

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Glossary, abbreviations, and acronyms

FBDGs	Food based dietary guidelines
GNPD	Global New Products Database
PAL	Physical activity level
RPC	Raw primary commodity
SSFD	Sugar-sweetened fruit drinks
SSSD	Sugar-sweetened soft drinks